

with some well-devised scheme of international observation. What is required is the means of giving an accurate general representation of atmospheric pressure, temperature, humidity and aqueous precipitation, together with the movements of the air as indicated by the direction and force of the wind, and of the phenomena more immediately connected with these movements. Of these last, the more important are clouds, their species and motions, and electrical and auroral manifestations.

These large inquiries naturally fall into two groups. The first group is concerned almost exclusively with the great movements of the atmosphere, and it is the adequate investigation of these inquiries which is aimed at by the United States Government in their great scheme of observations made at the same *physical instant* over the whole globe. This scheme may be called *cosmopolitan*.

The second scheme may, in contradistinction to the above, be called *international*. It includes those inquiries which deal with the large and vitally important subject of comparative climatology, or a comparison of the climates of different countries and regions, and of their meteorology generally, inclusive of the great movements of the atmosphere over a restricted portion of the globe, such as the United States, the North Atlantic, or Europe. It is altogether essential to the discussion of those inquiries which fall under this head that the observations be made at the same *local time* and with instruments so constructed and placed as to give results strictly comparable with each other. It is evident that the exposure of the thermometers, including their immediate surroundings and height above the ground, must be uniform in all countries; otherwise the observations, being incomparable, cannot be used in questions of international meteorology.

Of the recurring meteorological phenomena which first and most imperatively require to be dealt with internationally, both from their importance in atmospheric physics and from their intimate bearings on animal and vegetable life, are the daily changes which take place in the temperature, humidity, pressure, and movements of the atmosphere from 9 A.M. to 3 P.M. With observations at these hours, together with the daily maxima and minima of temperatures from a network of stations well spread over Europe, we should be put in a position of being able to inquire, with some hope of success, into the influence exerted on meteorological phenomena by different latitudes and elevations; by the Baltic, Caspian, Black, Mediterranean, and Adriatic Seas, the English Channel, and the Atlantic; and by the Swiss Alps, the mountain ranges of Great Britain and Norway, the scattered hills of Ireland, the elevated plateaux of Spain, and the extensive flats of Germany and Russia. We entirely concur with Prof. Plantamour in thinking that during recent years the study of the movements of the atmosphere has been too exclusively directed with a view to the application of the results to the prediction of storms on the coasts and to the system of storm-warnings, and that other points of view have been completely abandoned (Report, p. 58). It is right, however, to add that this neglect may be excused on the ground that, as there is an entire want of uniformity in the hours and modes of observing in the systems of meteorology as pursued in the different countries of Europe, the data for the investigations of nearly all the important questions of international meteorology do not exist.

It was a widespread feeling of a requirement of uniformity of procedure in the prosecution of meteorological researches in different countries which led many to look to the Congresses of Leipzig and Vienna as likely to secure this result; and it is a matter of regret that at these meetings nothing was done to bring about uniformity in the hours and modes of observing. Doubtless the question of international observations was under discussion at Vienna, but the feeling of the delegates regarding it, as indicated by the state of the vote and the large

number who abstained altogether from voting, was such that the only resolution arrived at was this, viz.: "That the best form of publication for the stations selected for international objects should be determined by the Permanent Committee, after consultation [*nach Anfrage*] with the directors of the central institutes."*

The matter accordingly came before the Permanent Committee at their meeting at Utrecht in September 1874, and after numerous explanations and a long discussion they unanimously resolved on a form for the publication of observations made for international objects (p. 7). This resolution is now being carried out by several of the countries represented at the Vienna Congress.

With reference to this resolution, however, it is to be remarked that (1) no provision was made by it for the observations being made at the same hours of the day; and as a matter of fact, the observations in the British Isles in connection with the scheme are 9 A.M. and 9 P.M.; in Russia, 7 A.M., 1 P.M., and 9 P.M.; in Norway, 8 A.M., 2 P.M., and 8 P.M.; in Italy, 9 A.M., 3 P.M., and 9 P.M.; in Austria, variously, and so on.

(2) No provision was made for securing uniformity as regards the vital question of the exposure and position of the thermometers, without which comparability is impossible.

(3) The forms adopted, both for the daily observations (p. 10) and for the monthly results (pp. 47-50) are in several respects defective, inasmuch as they do not include some of the more important data required in international inquiries.

The result will only be the printing of various sets of observations styled international, but which are not international—being, in truth, taken at their very best, merely national. By observations so made, no international question of meteorology can be satisfactorily discussed, and many international questions of the first importance, both practical and scientific, cannot even be attempted to be discussed.

When the subject was before the Vienna Congress, Plantamour urged the necessity of drawing a distinction between observations referring to the special study of the climate of each country, and those which are intended to indicate the simultaneous condition of the atmosphere over the whole surface of the earth (Report of Vienna Congress, p. 35). Until this be done, or until some such scheme as we have here indicated has been considered and agreed upon, it would be a mistake in meteorologists co-operating in carrying out a scheme which, while called international, completely fails to furnish the data required for international inquiries.

The only wise course the Permanent Committee can take at their next meeting is to rescind this resolution, as they have already virtually rescinded (p. 8) the resolution regarding rain-gauges all but unanimously passed at Vienna; and after consideration of the whole question to make provision that the instructions given them by the Vienna Congress with regard to this matter be carried out, viz., that no resolution be come to till after they have consulted the directors of the central institutes of the different countries; by which means they will furthermore be put in a position to propose a scheme which has been well matured, and therefore of such a character as will enlist in its behalf the general co-operation of meteorologists.

NOTES

WE can only this week join in the universal expression of regret at the death of Sir Charles Wheatstone, which took place at Paris on the 19th inst., at the age of seventy-three years. Inflammation of the chest was, we believe, the immediate cause of the sad result. The Paris Academy showed the greatest

* Protocol of the Ninth Meeting of the Congress.

interest in Sir Charles during his illness, and previous to the removal of his body to London a religious service was held at the Anglican chapel in the Rue d'Agueneau, at which a deputation from the Academy was present. MM. Dumas and Tresca delivered addresses, which will be published in the *Comptes Rendus*. Sir Charles was buried yesterday in his family burial-place at Kensal Green. We shall give a memoir in an early number.

THE following changes are proposed to be made for the ensuing session in the Council of the London Mathematical Society:—Profs. Cayley and Sylvester, having served their term of office, become ordinary members, and the Council recommend that their places be filled up by Lord Rayleigh, F.R.S., and Mr. W. Spottiswoode, F.R.S. Dr. Henrici, F.R.S., and Mr. H. Martyn Taylor are put in nomination to fill up the vacancies caused by the withdrawal of Mr. R. B. Hayward and Mr. W. D. Niven.

THE anniversary meeting of the foundation of the French Institute by the executive directors of the first French Republic was celebrated as usual on the 25th of October. The president was M. Lefuel, a member of the Academy of Fine Arts: he was assisted by delegates of the other academies. M. Lefuel had to perform the duty of awarding the great biennial prize (see vol. xii. p. 526) for 1875 to M. Paul Bert, member of the Versailles Assembly and a Professor of Physiology at the Sorbonne, for his discoveries relating to the part played by oxygen in the act of respiration. Although the report was presented to the Academy of Sciences at a secret sitting, it is expected that it will be published shortly, as the noblest part of the award is not the gift of a handsome sum of money, but the reasons why the prize had been adjudged to the candidate. After this the report for the prize established by the celebrated Volney was read at full length, and three lectures were delivered. The last one was by M. Mouchez, the new member of the Academy of Sciences, on the Venus Transit Expedition to St. Paul. The brave captain read it in plain sailor-like fashion and with much humour, and met with a most favourable reception.

THE Congress of Meteorologists, which was to have been held at Poitiers at the end of October, has been postponed for a month, and will be held on the 19th, 20th, and 21st Nov. next. It is to be styled the "Meteorological Congress of Western Oceanic France." All the departments situated within the space bounded by the Dordogne, the Atlantic, the Loire, and the central mountains of France, together with the Council of the Observatory of Paris, will be represented on the occasion. Among the representatives who will be present are MM. Belgrand, Renou, de Touchimbert, de Tastes, de la Gournerie, Lespiault, Raulin, and Leverrier, who will preside. Delegates from the departments of the regions adjoining are invited to be present to assist in laying the basis of a common understanding among the different regions in matters referring to meteorology.

A REUTER'S telegram, dated Rome, October 23, states that Mr. J. Norman Lockyer and Major Festing had arrived there, deputed by the British Government to propose to the Italian Government to send to the Exhibition at South Kensington in 1876 a collection of the instruments used by Italian professors in recent important astronomical observations.

PROF. BOYD DAWKINS, F.R.S., who left early in June for Australia, has returned to England *via* the Rocky Mountains Railroad and New York. The duties of the Geological chair at Owens College have been taken during his absence by Mr. C. E. De Rance, F.G.S., of the Geological Survey of England and Wales.

THE Commission on Vivisection have been meeting constantly during the past and present weeks, and have examined a considerable number of witnesses.

It is announced that the preliminary works for the Channel Tunnel are to be commenced this week near Calais. A shaft will be sunk to a depth of 100 metres.

As zoologists are not likely to look in the *Transactions* of the Society of Biblical Archaeology for anything concerning their own studies, especially in a paper entitled "The Tablet of Antefaa II," it may be as well to mention that this paper, by the learned president of the society, Dr. S. Birch, of the British Museum, in the last issued number of the *Transactions* (vol. iv. part i.), contains an interesting account, with numerous illustrations, of the different breeds of domestic dogs kept by the ancient Egyptians. It would appear from the drawings preserved on the walls of the tombs, that the variations of this animal in those early days were quite as well marked as those that may be seen at a modern dog-show.

THE Geographical Society of Paris held its first semi-monthly meeting of session 1875-1876 on the 20th of October; more than 190 members were present. The chair was filled by M. Delesse, the president of the central section. The correspondence was unusually long and interesting, and it is evident that geographical studies are advancing in France.

AN expedition under M. Largeau has been fitted out by the French Chambers of Commerce and private subscriptions to proceed to Rhadames from Algiers, and open communications with Soudan and Timbuctoo. The expedition is already on its way. A French paper, the *Rappel*, has sent a special correspondent with M. Largeau; this is perhaps the first time that any French journal has taken such a step.

NEWS has been received from the French Gaboon expedition under MM. Marche and Brazzi. These two gentlemen had arrived at St. Louis and selected a number of Laptops to accompany them in their excursions. The expedition is to last several years. A Government steamer was to conduct them from St. Louis to Gaboon.

A FRENCH expedition is being fitted out to make a "Tour du Monde" in ten months. The excursionists are to visit India, Japan, the interior sea of Japan, Chinese ports, Australia, &c. A special library, with instruments, will be placed on board. The members of this expedition will be exclusively of the male sex. The fare is to be 800*l.*, everything included. The Geographical Society will superintend the management of the enterprise, although it will be supported by private funds and is altogether a private speculation.

THE Marquis de Compiègne, the African explorer, has file for Cairo, where he has been appointed by the Khedive the acting secretary of the newly-established Khedival Geographical Society.

THE *Times* special correspondent at Suez, under date Oct. 26, telegraphs as follows with regard to African exploring expeditions:—"Despatches of the 14th and 20th of August, received yesterday, report that Lieut. Gordon was in Appudo with the steamer. The Kabba Regga people were intriguing. Linant saw Stanley, who had traversed Lake Victoria from south to north alone, at M'tesas. Cameron was at Tanganyika for eight months, trying to go the western route between Uganda and Zanzibar, which was interrupted by the Karaque tribe two degrees south. Subsequent despatches report the death of Linant in a fight with the Kabba Regga people. Lake Victoria is very large, and full of isles."

WE announced some time ago that the Italian Geographical Society was organising an expedition for African exploration. The Society has already raised 70,000 lire, which it expects its honorary president, Prince Humbert, to raise to 100,000 lire (4,000*l.*) The *Times* Milan correspondent sends additional

details. The Italian expedition is to be divided into two sections ; one is to set out from the Gulf of Aden for Tajuria, or Berbera, or some other port on the eastern coast of Africa, proceed to Shoa, and thence to Kaffa ; and from this great slave market it would make its way through an unexplored region to the central lakes, studying the hydrographic course of the eastern Nile. The other party would take its start from Khartoum, and, exploring the region lying between Monbootto and the Victoria Nyanza, push on, if it be practicable, as far as the great valley of Lualaba, discovered by Livingstone. The first-mentioned section of the expedition will be commanded by the Marquis Antinori, one of the vice-presidents of the Geographical Society, a distinguished ornithologist, who has spent several years in Central Africa, and whose travels in that region have won him a widespread reputation. He is now about seventy years old. The other section will be under the guidance of Ademoli, also familiar with the districts he proposes to explore, a young, brave, and strong man, known for his enthusiasm in the work of discovery, to which he has devoted himself.

FURTHER correspondence from members of the English Arctic Expedition confirms the news brought home by the *Pandora* that an unusually easy passage had been made to within 100 miles of the entrance to Smith Sound, and it is even expected that if circumstances continue equally favourable the pole may be reached this year. The expedition is not expected home, however, till the end of 1877. On July 23, the *Alert* met with the first accident ; she went on shore on a small island off Kingitok, but was floated off without injury as the tide rose.

LAST week we gave an abstract of Lieut. Weyprecht's paper on the principles which ought to guide Arctic exploration. Now it is stated that the Scientific Commission appointed by the German Government has reported, we believe in consequence of this paper, against the expediency of a fresh Polar Expedition, but has recommended the establishment of stations of observation in both hemispheres.

A PAPER of considerable interest, by Dr. Daniel Wilson, has been reprinted from the *Canadian Journal*. Its title is "Hybridity and Absorption" in relation to the Red Indian Race." Dr. Wilson, while of course admitting the patent fact that the American Indians, like most other barbarous races, have largely melted away before the white races, thinks that in accounting for this too much stress has been laid on mere extermination. He adduces data to prove that a very considerable proportion of red blood has been absorbed into the whites of North America, and that especially in the Canadian Dominion this shows itself in the physiognomy of all classes. It would be difficult, he believes, to find either in the United States or in Canada many Indians of pure breed. In Canada half-breeds are the almost universal representatives of the former Indian tribes, and many of them are settling down to a steady civilised life. In short, Dr. Wilson has what appears to us a well-founded belief that the aborigines of North America are being gradually absorbed into the dominant race, and that in course of time they will have become as integral a part of the population as any one of the elements which may be traced in the population of Europe, and that their physical and mental characteristics will tell upon the American character—just as Melanochroic attributes have left marked traces on the intrusive Xanthochroic European peoples. Fortunately the evidence gives good ground for believing that this influence is decidedly good, physically and intellectually. The characteristic "Brother Jonathan" face, which is generally attributed to influences of climate, soil, food, &c., Dr. Wilson is inclined to attribute to a decided admixture of Indian blood ; probably both causes have had to do with it. Dr. Wilson rightly advocates the most judicious and

humane treatment of the Indians both by the U.S. and Canadian Governments.

THE opening lecture of this session's Manchester Science Lectures for the People, the charge for admission to which is only one penny, was given on Tuesday last by Capt. Davis on "Arctic Discoveries." The other lectures are as follows :—Prof. Rucker on "Soap Bubbles;" R. Bowdler Sharpe, F.L.S., on "The Birds of the Globe;" Prof. J. Martin Duncan, F.R.S., on "The Great Extinct Quadrupeds;" Prof. Thorpe, F.R.S.E., on "Cavendish and his Discoveries;" Prof. Ferrier, F.R.S., on "The Functions of the Brains;" Prof. Henry E. Armstrong, on "Food;" William Pengelly, F.R.S., on "The Age of the Men of Kent's Cave." Part II.

A CIRCULAR, signed by Mr. W. Melton, who is judicial assessor on the Gold Coast, was issued last month by order of the Governor, "To the native kings, chiefs, captains, headmen, and principal men of the Gold Coast Colony," pointing out that "it is most desirable that the Gold Coast Colony should be well represented at the forthcoming International Exhibition at Philadelphia," and asking them to give all assistance in their power in sending contributions and collecting articles illustrative of the countries and districts over which they preside. Mr. Melton has issued a classified schedule of articles suitable for exhibition. Department I. Materials in their unwrought condition, mineral, vegetable, and animal. II. Materials and manufactures, the result of extractive or combining processes. III. Textile and felted fabrics, apparel, costumes, and ornaments for the person. IV. Furniture and manufactures of general use in construction and dwellings. V. Tools, implements, machines, and processes. VI. Boats and sailing vessels. VII. Apparatus and methods for the increase and diffusion of knowledge. VIII. (Not represented). IX. Plaster and graphic arts. As the arrangements are, we are told, in vigorous hands, and it is announced to the "native kings, chiefs," &c., that they may be reimbursed for any outlay they make, it is expected the collection from this colony will be extensive and interesting. In connection with this, Schweinfurth's "Artes Africanae," just published, is of interest : we shall give an early notice of this work.

IN reference to a recent note, p. 461, we are glad to see that at the Brighton meeting of the Social Science Association a resolution was passed requesting the Council to communicate with the authorities of the Science and Art Department of the Privy Council, suggesting the desirableness of making "Foods, their uses and preparation," the subject of examination.

IT seems that a good deal of the tobacco used in the manufacture of the so-called Havana cigars in Germany comes from Colombia, principally from Jiron, Ambalema, and Palmira, and that its quality is not of the first mark. Tobacco is also cultivated in the State of Bolivar, and is exported for a similar use.

MR. AMOS SAWYER contributes a short though interesting article to the *Transactions of the Academy of Science of St. Louis* on the cause of climatic change in Illinois. During the last twenty years, he says, the climate has been slowly, but surely, changing from wet to dry ; and although this change has been beneficial from a sanitary point of view, agriculturally considered it has been, and will hereafter prove to be, a great obstacle to the successful cultivation of the soil. The most important agent, in Mr. Sawyer's opinion, is what he calls the aqueous agent. The chemical and mechanical effects of this agency are constantly at work, and the result is plainly visible in the deepening of the channel of all the small streams. At the present time all the prairie land is in cultivation, or used as pasture ; the ponds and small lakes have become so filled up that they contain less than

half the former amount of water; the stock now consumes the reeds and marsh-grass, exposing the water to the direct rays of the sun, thereby promoting evaporation, so that by midsummer even the mud in their basins has dried to a hard crust, and a change in the temperature during the heated term brings, as a rule, a cool, dry atmosphere instead of rain, as in former years. Mr. Sawyer goes on to describe the large increase in the consumption of water by domestic animals. In this State at the present time there are at least "three million horses, cattle, and mules, and five million hogs and sheep, and they will consume not less than *seventy million gallons* of water every twenty-four hours—quite a lake of itself." This, surely, must be a misprint, or American animals are very thirsty beings!

A CORRESPONDENT of the *Aberystwith Observer*, the Rev. James Lewis, of Llanilar Vicarage, writes as follows to that journal:—"Whilst returning from service at the parish church of Rhosie, about 8.15 P.M. on Friday, the 24th ult., in company with two members of the congregation, my attention was called to a remarkably strange phenomenon. In walking across a field on the farm of Cwmclyd, it was noticed that our footsteps were marked by a peculiar light, which could be traced back for several yards, each footprint being as distinctly marked on the ground as when one walks in snow. When we got into the adjoining field the light disappeared until we came near to the end of it, when it was observed that our footsteps were again marked by the same luminous appearance. In colour the light was similar to that of phosphorus rubbed on a wall in a dark room, or a mass of glow-worms, of which insect, however, there was no trace on the surrounding ground."

IN the *Bulletin International* of the Paris Observatory for the 21st inst. appears an interesting note by M. de Lagrené on the thunderstorms which have occurred in the department of Haute-Marne during the seven years ending 1874. In this department the average annual number of thunderstorms is 87, of which 25 occur in July, 20 in May, and 14 in June. During the six months from October to March inclusive the mean annual aggregate is only six. The geographical position of Haute-Marne is an important one as regards these electrical phenomena, about which so very little is yet known, and this Departmental Meteorological Commission is doing good service in contributing its share in the work of collecting data on the origination, intensity, and rate of propagation of thunderstorms, and the manner in which they are influenced by the winds prevailing at the time, by the contour of the ground, and by forests.

WE have received the first number of the *Iowa Weather Review*, September 1875 (pp. 20), which has just been started by Dr. Gustavus Hinrichs, from which we learn that the system of rain observations set on foot by him, as explained in a recent notice in NATURE, is only the beginning of a more complete system by which it is hoped that the whole meteorology of this important State will be adequately and systematically observed and turned to practical account in the interests of the people. There is an idea shadowed out in the prospectus by which, if gone into and developed, the United States will be divided into meteorological districts or regions similar to what is now being done in France, and which is really the only means by which many highly important questions can be properly investigated. Dr. Hinrichs gives the monthly rainfall for the months of past years' observations, as well as the monthly means, at six places in the State, and sends a carefully compiled monthly report of his own observations made at the laboratory of the Iowa State University at Iowa City, the amounts and averages of each month being compared with the results of previous years' observations.

THE additions to the Zoological Society's Gardens during the past week include a Binturong (*Arctictis binturong*) from Malacca,

presented by Captain A. R. Ord; a Wood Owl (*Syrnium aluco*), European, presented by Mr. F. Brannd; a Missel Thrush (*Turdus viscivorus*), European, presented by Mrs. Watson; a Grey Wagtail (*Motacilla boarula*), seven Pickled Dog Fish (*Acanthias vulgaris*), European, purchased; a Cape Buffalo (*Bubalus caffer*) born in the Gardens.

ON THE VARIATIONS OF THE ELECTRO-MOTIVE FORCE OF A NEW FORM OF LECLANCHÉ'S CELL

A NEW form of Leclanché's cell has been constructed by Dr. Muirhead, and is supplied by Messrs. Warden, Muirhead, and Clark.

In this form the carbon and black oxide of manganese are packed in the outer case around a glazed porcelain jar perforated with holes about one-eighth of an inch in diameter, the jar containing a zinc plate bent into the form of a cylinder.

The advantages gained are that a much larger surface of zinc is exposed and the perforations of the jar are in no danger of being choked up by deposition of chloride of zinc.

The following results may be of some interest as showing how the electromotive force of this cell varies when it works for a considerable time through circuits of various resistances.

A circuit of known resistance was formed, through which the battery worked, and two points in this circuit were attached to the poles of a sawdust Daniell's cell, so as to form branch circuit in which a galvanometer was included; one of these two points was then moved along the circuit until the galvanometer showed that there was no current through the Daniell; when this is the case the E.M.F. of the battery is to that of the Daniell in the same ratio as the resistance of the whole circuit to that of the part between the points of attachment of the Daniell.

A set of coils was used by which the resistance could be adjusted to .05 ohm, and by adding one of these coils to the common part of the circuit (so that the resistance of the whole circuit did not remain quite constant) a very small change in E.M.F. could be measured.

The current through the Daniell was always very small, and as it passed sometimes in one direction and sometimes in the other, the difference between the potentials of its poles must have remained very nearly constant.

In the circuits of small resistance it became necessary to take account of the internal resistance of the cell. This was found (for these circuits) to be generally between .45 and .46, it was subject to slight variations between these limits, but rarely exceeded them when the battery was worked for only two or three hours, although on leaving the battery circuited through 30 ohms for 20 hours it rose as high as .525. The lowest resistance observed was .420 when working through 10 ohms.

The following tables give the E.M.F. of the battery in terms of the Daniell:—

When the cell had been circuited through 10 ohms for 2 min., the E.M.F. was 1.320; for 3½ min., 1.314; for 5½ min., 1.304; for 13 min., 1.292; for 23 min., 1.283; for 34 min., 1.277. For 1h. 1m., 1.266; for 1h. 31m., 1.256; for 1h. 56m., 1.254; for 2h. 11m., 1.253.

When circuited through 20 ohms for 2½ min. the E.M.F. was 1.3405; for 4 min., 1.3420; for 5½ min., 1.3385; for 13 min., 1.3315; for 18 min., 1.3270; for 30 min., 1.3215; for 46 min., 1.3155. For 1h. 1m., 1.3095; for 1h. 22m., 1.3045; for 1h. 31m., 1.3035.

When circuited through 30 ohms for ½ min. the E.M.F. was 1.3702; for 2 min., 1.3608; for 3 min., 1.3585; for 4 min., 1.3562; for 10 min., 1.3500; for 20 min., 1.3446; for 26 min., 1.3404; for 28 min., 1.3391. For the next four minutes the E.M.F. was very unsteady. For 32 min., 1.3411; for 33 min., 1.3398; for 39 min., 1.3364. For 1h. 3m., 1.3318; for 1h. 14m., 1.3292; for 1h. 28m., 1.3211; for 23h. 30m., 1.2810.

When circuited through 100 ohms for 7 min. the E.M.F. was 1.4415; for 10 min., 1.4417; for 20 min., 1.4423.

No further change was observed at the expiration of one hour.

When the cell (after being insulated for 21 hours) was circuited through 3,200 ohms, after 1 min. the E.M.F. was 1.448; after 3 min., 1.450; after 18 min., 1.454; after 38 min., 1.459.

When the cell was short circuited through itself for two minutes the E.M.F. fell from 1.407 to 1.235. (These measurements were taken with the cell working through 3,500 ohms.)